EFFECT OF FLY ASH AS PARTIAL CEMENT REPLACEMENT ON PROPERTIES OF LIGHTWEIGHT CONCRETE SUBJECTED TO AIR CURING

INTAN SURAYA BINTI A.RAHIM

B. ENG(HONS.) CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

_____

(Supervisor's Signature)

Full Name : DR. KHAIRUNISA BINTI MUTHUSAMY

Position : SENIOR LECTURER

Date : 13 JUNE 2018

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

_____

(Student's Signature)

Full Name : INTAN SURAYA BINTI A.RAHIM

ID Number : AA14139

Date : 13 JUNE 2018

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ABSTRAK

Abu terbang dan batu dandang minyak sawit merupakan bahan terbuang yang boleh menyebabkan pencemaran alam sekitar. Oleh itu, kajian ini adalah untuk menyiasat kesan abu terbang sebagai gantian simen separa pada kebolehkerjaan, kekuatan mampatan dan kekuatan lentur konkrit ringan yang diawet pada udara. Lima jenis campuran akan digunakan dalam kajian ini. Konkrit yang mengandungi 100% simen akan bertindak sebagai spesimen kawalan. Manakala, bancuhan konkrit selebihnya akan menggunakan abu terbang dengan peratusan yang berlainan dari 10%, 20%, 30% dan 40%. Semua specimen diawet pada udara. Kekuatan mampatan dan kekuatan lentur dijalankan pada 7, 14 dan 28 hari. Keputusan menunjukkan bahawa kebolehkerjaan meningkat dengan pertambahan abu terbang dalam kandungan konkrit segar. Manakala untuk kekuatan mampatan dan kekuatan lentur, ia menunjukkan bahawa kekuatan konkrit abu terbang adalah lebih tinggi daripada konkrit tanpa abu terbang. Pada 28 hari, campuran 10% abu terbang merekodkan nilai tertinggi pada kekuatan berbanding dengan peratusan abu terbang konkrit yang lain. Keputusan menunjukkan bahawa kita boleh menggantikan sebahagian simen dengan bahan buangan, supaya kita boleh mengurangkan pengeluaran karbon dioksida ke atmosfera dan juga menjimatkan bahan semula jadi.

ABSTRACT

Fly ash and palm oil boiler stone are waste product that causes environmental pollution. Thus, this research study is to investigate the effect of fly ash as partial cement replacement on workability, compressive strength and flexural strength of lightweight concrete subjected to air curing. Five mixtures were used in this research. The mix containing 100% cement would act as a control specimen. The rest of the mixes contained various percentage of fly ash which are 10%, 20%, 30% and 40%. The samples were subjected to air curing. Compressive strength and flexural strength conducted at 7, 14 and 28 days. The results revealed that the workability increases with the increase in the use of fly ash content. For both compressive strength and flexural strength, it shows that fly ash concrete is much higher than the concrete without fly ash. The mix containing 10% of fly ash recorded the highest strength value compared to other percentage of fly ash concretes at 28 days. The results showed that we can partially replace the cement with the waste material, therefore we can reduce the emission of carbon dioxide into the atmosphere and save natural material.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

%	Percent
°C	Degree Celcius
Mpa	Megapascal
kg/m^3	Kilogram per cubic meter
Mm	Micrometer
Mm	Milimeter
m^2/kg	Meter square per kilogram
N	Newton

LIST OF ABBREVIATIONS

POBS	Palm Oil Boiler Stone
LWAC	Lightweight Aggregate Concrete
ASTM	American Standard Testing
CEA	Central Electricity Authority
FESEM	Field Emission Scanning Electron Microscope
CO_2	Carbon dioxide
SO_2	Sulfur dioxide
SCM	Supplementary Cementitious Material
LW	Lightweight Concrete
OPC	Ordinary Portland Cement
YTL	Yeoh Teong Lay

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

In recent years, with the development of economy and growth of urban population, buildings have been more and more intensive and led to high demand for cement use. Cement is actually an environmentally hazardous material that produces a lot of carbon dioxide emissions that can contribute to global warming. In addition, high usage of natural resources would result in a high amount of industrial wastes. Therefore, to prevent the issue on environmental concerns, artificial aggregates such as fly ash and palm oil boiler stone can be used as substitutes to produce an environmentally friendly lightweight concrete. Utilization of industrial wastes as a construction material is a healthy sustainable practice to dispose the waste and conserve the available resources for future generations (Nadesan, 2017).

At the same time, huge quantities of fly ash and palm oil boiler stone were found in the world but the only certain amount of it is being used while the rest was disposed of in landfills. Fly ash and palm oil boiler stone are a waste product that can cause environmental pollution quality and human health. Fly ash is derived from coal-burning power plants while palm oil boiler stone is from burning of solid wastes in the boiler combustion process. According to the annual survey results published by American Coal Ash Association, about one ton of carbon dioxide can be reduced per each ton of coal fly ash used in place of common Portland cement (Argiz, 2017). By using fly ash and palm oil boiler stone in concrete production, this will reduce the usage of natural resources.

1.2 PROBLEM STATEMENT

In the future raw material and alternative fuels that involved in the production of cement would become extinct. Hence, cement's price and market demand would increase due to lack of resources. Therefore, resulting carbon dioxide emission making it be not sustainable in construction activities (Tam, 2009). Other than that, fly ash having a high content of toxic that can cause human health. The fly ash and POBS are waste product disposed to dumping places that cause environmental pollution and problems. Thus, these wastes must be eliminated or reduced to protect the environment.

1.3 OBJECTIVES

This study was conducted to achieve the following objectives:

i. To determine the workability of the lightweight aggregate concrete containing fly ash as partial cement replacement.

ii. To determine the compressive strength of the lightweight aggregate concrete containing fly ash as partial cement replacement.

iii. To determine the flexural strength of the lightweight aggregate concrete containing fly ash as partial cement replacement.

1.4 SCOPE OF RESEARCH

The study aims to investigate the properties of LWAC in term of workability, compressive strength and flexural strength when fly ash as partial cement replacement. Various percentage of fly ash range from 0%, 10%, 20%, 30% and 40% have been used as a partial cement replacement in concrete. There are two types of specimens which are a cube and beam. The sample size for the cube is about 100 x 100 x 100 mm for compressive strength. The beam is about 100 x 100 x 500 mm for flexural strength. All specimens were subjected to air curing. The curing was conducted at 7, 14 and 28 days. All the testing was conducted at Concrete Laboratory.

1.5 SIGNIFICANCE OF RESEARCH

The use of fly ash and waste product in the production of concrete can reduce the utilization of raw material and avert it from extinction. Benefits of using fly ash and palm oil boiler stone are our environment become cleaner and environmentally friendly. Besides that, the cost to make a concrete will decrease by using these waste. Other than that, it can reduce the fly ash and POBS wastes ending at the landfill.

1.6 LAYOUT OF THESIS

Chapter one is introduced to investigate the problem statements and outlining objective to be achieved. The scope of research and contribution of the study is also included in this section. The chapter ends with the layout of the thesis. Chapter two discusses the utilization, properties, application, and pollution of fly ash and palm oil boiler stone. This includes the review of previous research on lightweight aggregate concrete.

Chapter three discusses the methodologies used in this study. The preparation of mixing ingredients and apparatus used in conducting the experiment is reported in this section. The testing procedures also discussed in this chapter three. Chapter four discusses laboratory results of POC lightweight aggregate concrete incorporated with fly ash. Data that has been analysed and made in form of graph for workability, compression strength and flexural strength test result is presented in this chapter.

Chapter five concludes the whole study. The conclusions are drawn from respective objectives listed based on the results obtained from the testing. The recommendations for future study also in this chapter.

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